Some Comments on the Functional Structure of E-Textbooks

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Abstract: Creating a textbook on a subject that is a leading component of educational content in the process of globalization. In the process of designing the textbook, not only specialists in the field of narrow subject science, but also specialists in the field of electronic textbook didactics, psychologists and, most importantly, programmers responsible for the final implementation of the project. To facilitate the software, to adapt the textbook and to create individual learning trajectories, the educational material (electronic textbook content) is divided into functional units. A graphically oriented approach to the structure of the learning material is the construction of individual learning trajectories, a person-centered approach to teaching

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We will concentrate on describing the distinct structure developed during the process of writing a textbook on the subject, which has "methods of activity" as its primary component.

The mandatory element of the first structural unit is a system of typical issues, and examples of textbooks in the basic material of topics like mathematics, as we previously said, comprise not only the fundamentals of science but also descriptions of techniques of action. The whole range of learning activities should be covered by typical questions, which should be numbered sequentially to enable the creation of rapid linkages. Similarly, each rule of the theoretical part must be provided with hyperlinks. The learning process organization block includes three types of practical tasks: test, self-study, and control tasks. The tests are designed to test the user's understanding of the basic definitions and rules of the theoretical part, i.e their readiness for further work.

The process of learning activities arranged through educational concerns results in the development of action skills and competencies. These issues can be provided with the same dose of pedagogical assistance as in the CLASS NET textbook series, with the student referring to the instructions at his or her own discretion. The structure of the e-textbook includes various types of instructions: reference questions, references to theoretical rules, references to typical examples, and finally, a detailed solution to the problem. The third type of control has no guidelines and, as we have noted, is for control and self-control. Unless there is a need to solve other types of problem systems, they can be expanded by filling them in with creative issues that the student addresses on a topic of their choice if they want to look at the topic they are studying from a non-standard or other perspective.

All e-textbook tasks are provided with a certain level of complexity, which is first determined by the expert on the basis of assessment of the number of actions and theoretical rules used in the empirical generalization and solution, and then the statistics of the user's performance using special methods of mathematical statistics, corrected by data collection [1]. The passage of the task block is regulated by the fact that a certain level of correctly solved tasks assigned by the student tutor exceeds the overall complexity.

Most scenarios use a block of statistics that includes student grades and assignment time, their

activity during the semester, the results of control activities, and attendance (for full-time students). We highlight the block of statistics, which is used in all the described scenarios of using the electronic textbook and is not available in print. The student can see his or her accomplishments, his or her place in the stream and group rankings compared to his or her peers, and his or her group's place in the faculty "tournament" table, which creates social motivation for learning. This block also includes information that was not obtained through the e-textbook itself, such as information entered by the teacher. It can include the student's marks in the regular supervision tasks and details about attendance in the regular classroom setting. The teacher can use additional statistics: in addition to the listed parameters, we estimate the time a student spends on solving a particular task, the amount of time he or she spends in the group on each task, the sum of the number of students who solved the task and who made mistakes while solving it, which can give information not only about the difficulty of the task, but also about possible shortcomings in the lesson.

The block of statistics should be divided into separate structural units, as it has its own functional load.

For the same reasons, we include a block of evaluation tools as part of the functional structure. Its responsibilities include assessing the complexity of each task based on statistics about the number of students who completed it correctly and the time it took to complete it; assess the user's level of knowledge based on those parameters; this includes obtaining an initial grade point average that corresponds to the control rating form provided for in the federal state education standard. The use of statistical methods of processing information about the work of users allows to organize feedback and provide features of adaptation to the electronic textbook, ie to automatically change the content set depending on the level of knowledge and skills of the student and allows you to customize the usage scenario. The block of assessment tools is both an element of the textbook and an element of the electronic control shell, as well as a navigation device.

Due to the need to implement different usage scenarios, we will focus on the following components of the e-textbook aimed at shaping the methods of operation:

1) basic material with explanatory texts and interactive illustrations containing a set of theoretical rules and typical problems;

2) audio and video clips revealing the history of scientific thinking, methods of scientific knowledge, etc., additional materials in the form of cognitive materials;

3) a practical part consisting of blocks of creative assignments of the student's choice, testing, teaching and controlling the level of mastering the educational material;

4) a block of statistical data on the results of the use of electronic textbooks by students;

5) a block of tools to assess the complexity of the issues, the level of mastery of the learning material by students.

The specified structure of the e-textbook corresponds to the client-server form of access to the educational material, which allows it to integrate organically into the university education portal and implement the scenarios described above for different categories of users.

Thus, the scenario approach to defining the structure of an electronic textbook is as follows: the type of subject determines the scenarios for the use of an electronic textbook by different subjects of the learning process, which determines the functional elements of the structure of the electronic textbook. Therefore, the scenario approach is the basis of the multifunctional didactic principle of using an electronic textbook, which provides for its use by different categories of users and provides the necessary functional elements of the structure.

In the process of designing a textbook, not only narrow subject matter specialists, but also e-textbook didactic specialists, psychologists and, most importantly, the team of programmers

responsible for the final implementation of the project should be the product of joint work.

At the university level, an e-textbook can serve as an object of interdisciplinary research, from the problem of its design to its use. The form and sequence of presentation of educational material is subject to didactic and psychological laws, the display of information on the screen is determined by the laws of perception, the creation of a software shell is carried out using information technology, which can be checked requires the construction of various mathematical models [105] that can be done by mathematical methods.

In order to facilitate the software, to adapt the textbook and to create individual learning trajectories, it is necessary to create the training material (e-textbook content) in more detail than to divide it into functional units. Well-studied mathematical objects, such as weighted graphs, can be used to solve this problem. This is a set of vertices and arcs connecting them, and each arc can be assigned a number (arc weight) and the direction of movement, i.e. which of the connected vertices should move. The use of mathematical graph theory to create e-textbook content is called a graph-oriented approach.

A graphically oriented approach to the structure of the learning material allows the construction of individual learning trajectories, the use of a person-centered approach to teaching, that is, taking into account the individual characteristics of students, their level of training and psychological characteristics.

The essence of the graph-oriented approach is the ability to express different learning scenarios and trajectories of the course in the form of weighted graphs. At the ends of the graph are content elements (problems, various tests, theoretical rules, creative assignments, etc.), the direction of the arcs determines the sequence of these elements, network points adapt the learning process to the individual characteristics of the student. The weight can be the complexity of the tasks or the time required to complete them. Initial values can be determined by experts or empirically, and then automatically or adjusted by the teacher depending on the level of knowledge of the students. In this case, each learning trajectory is modeled as a path in a graph [2]. In constructing this mathematical structure, the order of study of the topics, their interdependence, the complexity of the tasks, and the degree of independence of the students in solving them should be followed.

There are many mathematical algorithms for finding the path in a graph with different optimization criteria, which can be used to solve the following didactic problems:

1) create a set of individual tasks of the required level of complexity to control the formation of users' learning competencies (in this case, the weights of the graph arcs are used to determine the complexity of the tasks);

2) build individual learning trajectories of users to ensure the most effective mastering of the learning material (the choice of the graphic arc is made interactively depending on the student's response);

3) adapting the content of the e-textbook for a specific audience of users (recalculation of weights of complexity of tasks, weights related to learning competencies, test times, etc.). Other aspects of the application of graph theory can be used, including those related to the technical implementation of the project.

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